Docket No.: 50212-514 PATENT

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

In re Application of	:	Customer Number: 20277
Motoki Kakui, et al.	:	Confirmation Number: 8492
Serial No. 10/615,389	:	Tech Cneter Art Unit: 3663
Filed: July 9, 2003	:	Examiner: Diacou, Ari M.

FOR: OPTICAL AMPLIFCATION MODULE OPTICAL AMPLIFICATION APPARATUS AND OPTICAL COMMUNICATIONS SYSTEM

TRANSMITTAL OF APPEAL BRIEF

Commissioner for Patents
Washington, DC 20231
Sir:

Submitted herewith in triplicate is Appellant(s) Appeal Brief in support of the Notice of Appeal filed June 3, 2003. Please charge the Appeal Brief fee of $500.00 to Deposit Account 500417.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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Please recognize our Customer No. 20277 as our correspondence address.

Application No.:

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
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For: OPTICAL AMPLIFICATION MODULE OPTICAL AMPLIFICATION APPARATUS AND OPTICAL COMMUNICATIONS SYSTEM

APPEAL BRIEF

Mail Stop Appeal Brief
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This Appeal Brief is submitted in support of the Notice of Appeal filed July 25, 2006.

I. REAL PARTY IN INTEREST

The real party in interest is Sumitomo Electric Industries, Ltd.

II. RELATED APPEALS AND INTERFERENCES

Appellants are unaware of any related Appeal or Interference.

III. STATUS OF CLAIMS

Claims 2 through 79 are pending in this Application, of which claims 13 through 27, 35 through 40 and 42 through 44 stand withdrawn from consideration pursuant to the provisions of 37 C.F.R. § 1.142(b). Claims 2 through 12, 28 through 34, 39, 41 and 45 through 79 have been finally

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rejected. It is from the final rejection of claims 2 through 12, 28 through 34, 39, 41 and 45 through 79 that this Appeal is taken.

IV. STATUS OF AMENDMENTS

An Amendment was filed under 37 C.F.R. § 1.116 on May 31, 2006, subsequent to the February 3, 2006 Final Office Action. The Examiner issued an Advisory Action on June 12, 2006 declining to enter the May 31, 2006 Amendment under 37 C.F.R. § 1.116.[1]

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

Independent Claim 3.

Claim 3 is directed to an optical amplification module for collectively amplifying signal light having multiplexed a plurality of channels in a single wavelength band including a wavelength region having a wavelength of 1610 nm or longer (page 6 of the written description of the specification, lines 19 through 25). The claimed optical amplification module comprises a Bi oxide based optical waveguide doped with Er for propagating the signal light (page 6 of the written description of the specification, line 21, and line 26 through page 7, line 1); a pumping light system for supplying the optical waveguide region with pumping light to generate a population inversion within the optical waveguide region (page 7, lines 2 through 6); and a control unit for adjusting the power of the pumping light supplied from the pumping light supply system to the Bi oxide based optical waveguide to yield a relative gain non-uniformity of less than 25% in a net gain spectrum of the Bi oxide based optical waveguide at a predetermined operating temperature within an operating temperature range of the optical amplification module (page 8, line 21 through page 9, line 4).

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[1] The only amendment implemented in the May 31, 2006 Amendment was to change the dependency of claim 39 from cancelled claim 1 to claim 3. Appellants submit that the Examiner's refusal to enter that Rule .116 Amendment is arbitrary as it serves no useful purpose.

Independent Claim 5.

Claim 5 is directed to an optical amplification module similar to that defined in claim 3, but differs from claim 3 by specifying that the control unit adjusts the optical power of the pumping light supplied from the pumping light system to yield a relative gain non-uniformity of less than 25% in a net gain spectrum of said Bi oxide based optical waveguide within a whole operating temperature range of the optical amplification module (page 8, line 19 through page 9, line 4).

Independent Claim 7.

Claim 7 is also directed to an optical amplification module similar to that set forth in claim 3, but specifies that the control unit for adjusting an optical power of the pumping light supplied from the pumping light system to the Bi oxide based optical waveguide yields a relative gain non-uniformity of less than 25% in a net gain spectrum of the Bi oxide based optical waveguide in a wavelength band exceeding 37 nm within the entire operating temperature range of the optical amplification module (page 9, lines 5 through 11).

Dependent Claim 8.

Claim 8 depends from claim 7, and specifies that the wavelength band exceeds 50 nm (page 9, line 9).

Independent Claim 9.

Claim 9 is directed to an optical amplification module similar to claim 3, but differs from that defined in claim 3 in reciting that the control unit yields a relative gain non-uniformity of less than 19% in a net gain spectrum of the Bi oxide based optical waveguide in a wavelength band exceeding

37 nm within a whole operating temperature range of the optical amplification module (page 8, line 21 through page 9, line 4).

Dependent Claim 10.

Claim 10 depends from claim 9 and specifies that the wavelength band exceeds 50 nm (page 9, line 9).

Independent Claim 11.

Claim 11 is directed to an optical amplification module similar to that defined in claim 3, but differs from that defined in claim 3 in that a control unit is not specified and a temperature detecting device for detecting a temperature of the Bi oxide based optical waveguide or nearby (page 9, lines 18 through 21) is specified.

Independent Claim 12.

Claim 12 is directed to an optical amplification module similar to that defined in claim 11, but differs from that definite in claim 11 in that, instead of specifying a temperature detecting device, a temperature adjusting device for adjusting a temperature of the Bi oxide based optical waveguide or nearby (page 9, lines 22 through 24) is specified.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Claims 39 and 41 stand finally rejected under the fourth paragraph of 35 U.S.C. § 112;

2. Claims 2 through 12, 28 through 34, 39, 41 and 45 through 79 stand finally rejected under the first paragraph of 35 U.C.S. § 112 for lack of adequate enabling support;

3. Claims 8 and 10 stand finally rejected under the first paragraph of 35 U.S.C. § 112 for lack of enabling support; and

4. Claims 2 through 10, 28 through 34 and 45 through 65 stand finally rejected under the first paragraph of 35 U.S.C. § 112 for lack of adequate enabling support.

VII. ARGUMENT

1. **The rejection of claims 39 and 41 under the fourth paragraph of 35 U.S.C. § 112.**

The Examiner accurately notes that claim 39 improperly depends from cancelled claim 1, an admittedly typographical oversight. Appellants attempted to remedy this error and moot the rejection by filing an Amendment under 37 C.F.R. § 1.116 changing the dependency of claim 39 to claim 3. The Examiner refused entry.

Appellants submit that the Examiner's refusal to enter the May 31, 2006 Amendment pursuant to 37 C.F.R. § 1.116 is arbitrary, serves no useful purpose, and only burdens the Honorable Board of Patent Appeals and Interferences with unnecessary issues.

Appellants do not contest this rejection. However, Appellants do solicit the Honorable Board to exercise its discretion pursuant to 37 C.F.R. § 41.5(c) and include an explicit statement that this rejection can be overcome upon amending claim 39 to depend from claim 3.

2. **The rejection of claims 2 through 12, 28 through 34, 39, 41 and 45 through 79 under the first paragraph of 35 U.S.C. § 112 for lack of adequate enabling support.**

In the statement of the rejection the Examiner asserted that the expression "for collectively amplifying ... a wavelength of 1610 nm or longer" is an open ended numerical expression inclusive of IR, microwave and radio radiation, for which there is no enabling support. The Examiner is wrong.

Lack of enablement under the first paragraph of 35 U.S.C. § 112 is a question of law. *U.S. Steel Corp. v. Philips Petroleum Co., 865 F.2d 1247, 9 USPQ2D 1461 (Fed. Cir. 1989); U.S. v. Telectronics Inc., 857 F.2d 778, 8 USPQ2d 1217 (Fed. Cir. 1988).* In rejecting a claim under the first paragraph of 35 U.S.C. § 112 for lack of adequate enabling support, it is incumbent upon the Examiner to establish a basis in fact and/or cogent technical reasoning to support the ultimate legal conclusion that one having ordinary skill in the art would not be able to practice the claimed invention, armed with the supporting specification, without undue experimentation. *In re Cortright, 165 F.3d 1353, 49 USPQ2d 1464 (Fed. Cir. 1999); In re Brana, 51 F.2d 1560, 34 USPQ2d 1436 (Fed. Cir. 1995); In re Marzocchi, 439 F.2d 220, 169 USPQ 367 (CCPA 1971).* Appellants emphasize, what the Examiner apparently does not or refuses to recognize, that a patent disclosure is directed to one having ordinary skills in the art. *In re Howarth, 654 F.2d 103, 210 USPQ 589 (CCPA 1981).* Appellants also emphasize that a patent disclosure is presumed enabling in the absence of a reason to doubt the objective truth of the statements contained therein. *In re Cortright, supra; In re Brana, supra; In re Marzocchi, supra.*

In applying the above legal tenets to the exigencies of this case, Appellants submit that the Examiner did not establish a *prima facie* basis to deny patentability to the claimed invention under the first paragraph of 35 U.S.C. § 112 for lack of adequate enabling support. Specifically, the Examiner did not overcome the presumption of enablement, as by advancing technological reasoning to doubt the statements in the specification, or by establishing that the **properly construed claimed invention** is inherently unbelievable or involves implausible scientific principles. *In re Cortright, supra.*

In this respect Appellants submit that the Examiner's interpretation of the claimed invention is not realistic, ignores express claim language and is inconsistent with how one having ordinary skill in the art would have interpreted the claimed invention in the **context** of the present disclosure. *Phillips*

v. AWH Corp., 415 F.3d 1303, 75 USPQ2d 1321 (Fed. Cir. 2005) (en banc). Specifically, as **expressly** set forth in claim 3, for example, the invention is concerned with amplifying **signal light**. In other words, the indicated wavelength range is, as the claims say, **for signal light**.

The Examiner's theoretical extrapolation of the claimed invention ignores the explicit claim requirement for amplifying **signal light**, because microwave radiation and radio waves, for example, are not amplification targets of the claimed invention involving **signal light** amplification, as would have been understood by one having ordinary skill in the art.

Similarly, the Examiner's interpretation that the claimed invention is inclusive of "f=0" is unrealistic and inconsistent with how one having ordinary skill in the art would have interpreted the claimed invention. This is because the claimed invention relates to amplifying **signal light** and, hence, one having ordinary skill in the art would have understood that f could not equal 0.

As one having ordinary skill in the art would have understood from the context of the present disclosure, and indeed from the express language of the claims, i.e., "a signal wavelength band including a wavelength region having a wavelength of 1610 nm or longer" simply denotes a wavelength region to be employed. One having ordinary skill in the art would have understood that the limitation does not suggest that any and all wavelength regions over 1610 nm may be employed as "a single wavelength band."

The Examiner conveniently and unrealistically assumed a wavelength of infinite length. Based upon that unrealistic assumption, the Examiner decided that the claimed invention includes f=0. Again, the Examiner ignores the fact that the claims are limited by the wording "signal **light**". The Examiner suggests that the claimed signal to be amplified includes something one having ordinary skill in the art would not have understood as light, i.e., microwave radiation, radio waves, etc. The

Examiner conveniently over expanded the scope of the claimed invention in an unrealistic manner in order to set up a straw man to reject.

Based upon the foregoing Appellants submit that one having ordinary skill in the art would have no difficulty practicing the claimed invention armed with the supporting specification without undue experimentation. *In re Cortright, supra.* Appellants, therefore, submit that the imposed rejection of claims 2 through 12, 28 through 34, 39, 41 and 45 through 79 under the first paragraph of 35 U.S.C. § 112 is not legally viable.

3. **The rejection of claims 8 and 10 under the first paragraph of 35 U.S.C. § 112 for lack of enabling support.**

In the statement of the rejection the Examiner asserted that the disclosure does not enable the rejected claims because the expression "wherein the bandwidth exceeds 50 nm" is open ended. Appellants disagree.

The Examiner again did not discharge the initial burden of establishing that **one having ordinary skill in the art** would not have been able to practice the claimed invention, armed with the supporting specification, without undue experimentation by overcoming the presumption of enablement, as by advancing technological reasoning to doubt the statements in the specification or by establishing that the claimed invention is inherently unbelievable or involves implausible scientific principles. *In re Cortright, supra.* Specifically, and as previously argued, the Examiner's interpretation of the claimed invention is inconsistent with how one having ordinary skill in the art would have interpreted the claimed invention. This is because the indicated range relates to **signal light** and, hence, confined within **signal light**.

Further, claims 8 and 10 depend from claims 7 and 9, respectively. For reasons set forth in traversing the rejection of claims 7 and 9 under the first paragraph of 35 U.S.C. § 112 for lack of adequate enabling support, the rejection of claims 8 and 10 is equally without legal merit.

The Examiner's theoretical extrapolation of the claimed invention beyond **signal light** is unjustified and inconsistent with the manner in which how one having ordinary skill in the art would have interpreted the claimed invention. *Phillips v. AWH Corp., supra.*

Based upon the foregoing Appellants submit that the imposed rejection of claims 8 and 10 under the first paragraph of 35 U.S.C. § 112 is not legally viable.

4. The rejection of claims 2 through 10, 28 through 34 and 45 through 65 under the first paragraph of 35 U.S.C. § 112 for lack of adequate enabling support.

In support of this rejection, the Examiner asserted that the disclosure "... does not reasonably provide enablement for a gain non-uniformity of 0%*" (first paragraph on page 5 of the February 3, 2006 Office Action). The Examiner's position is unrealistic.

The Examiner again did not provide a basis upon which to predicate the ultimate legal conclusion that one having ordinary skill in the art would not have been able to practice the claimed invention, along with the supporting specification, without undue experimentation. The Examiner did not overcome the presumption of enablement as by advancing technological reasoning to doubt the statements in the specification, or by establishing that the claimed invention is inherently unbelievable or involves implausible scientific principles. *In re Cortright, supra.*

Specifically, the wording "so as to yield a relative gain non-uniformity of less than 25%" is clearly distinguishable from "so as to yield a relative gain non-uniformity of 0%" as interpreted by the Examiner. This is because the claim wording merely describes a target value of amplification control

and, hence, would have been understood by one having ordinary skill in the art to mean "so as **not** to yield a relative gain non-uniformity of 25% **or larger**".

In other words, in accordance with the claimed invention, control can be achieved when the relative gain non-uniformity simply decreases as, for example, from 26% to 24%. As one having ordinary skill in the art would have understood, it is **not**, repeat **not**, an object of the present invention to yield a relative gain non-uniformity of 0%. Simply put, the Examiner's interpretation far exceeds the scope of the rejected claims by intentionally assuming an impossible case where a relative gain non-uniformity is zero.

The limitation "so as to yield a relative gain non-uniformity of less than 25% in a net gain spectrum ..." would not have suggested to one having ordinary skill in the art a wavelength band of infinite length. In order for the Examiner to reach the absurd conclusion that one having ordinary skill in the art would have interpreted the claims to encompass a relative gain non-uniformity of 0%, the Examiner must interpret the wavelength band to be of **infinite scope**. This is technologically incoherent.

The bottom line is one having ordinary skill in the art would never have interpreted the claimed invention to encompass a relative gain non-uniformity of 0%. This is because, technologically speaking, it is inconceivable that one having ordinary skill in the art would have interpreted the claimed invention to encompass an impossible case where the relative gain non-uniformity is 0%. *Phillips v. AWH Corp., supra*. On the other hand, apart from interpreting the claims unreasonably and inconsistent with the written description of the specification, and inconsistent with how one having ordinary skill in the art would have interpreted the claimed invention, the Examiner did not provide any support for the asserted legal conclusion of non-enablement under the first paragraph of 35 U.S.C. § 112.

Appellants, therefore, submit that the imposed rejection of claims 2 through 10, 28 through 34 and 45 through 65 under the first paragraph of 35 U.S.C. § 112 for lack of adequate enabling support is not legally viable.

VIII. CONCLUSION

Based upon the foregoing Appellants submit that the Examiner's rejections under the first paragraph of 35 U.S.C. § 112 for lack of adequate enabling support are based upon a clearly erroneous claim interpretation to encompass, for example, an infinite wavelength band, and ignores the express claim limitation "signal light". Appellants further submit that the Examiner did not establish a *prima facie* basis to deny patentability to the claimed invention under the first paragraph of 35 U.S.C. § 112 for lack of adequate enabling support. Appellants, therefore, submit that each of the Examiner's rejections under the first paragraph of 35 U.S.C. § 112 for lack of adequate enabling support is not legally viable.

IX. PRAY FOR RELIEF

Based upon the arguments submitted *supra*, Appellants submit that the Examiner's rejections under the first paragraph of 35 U.S.C. § 112 for lack of adequate enabling support are not legally viable. Appellants, therefore, solicit the Honorable Board to reverse each of the Examiner's rejections under the first paragraph of 35 U.S.C. § 112 for lack of adequate enabling support.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due under 37 C.F.R. 1.17 and 41.20, and in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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Date: August 16, 2006

Please recognize our Customer No. 20277 as our correspondence address.

CLAIMS APPENDIX

2. An optical amplification module according to claim 3, wherein the optical waveguide region doped with Er element is further doped with B element.

3. An optical amplification module for collectively amplifying signal light having multiplexed a plurality of channels in a single wavelength band including a wavelength region having a wavelength of 1610 nm or longer, said optical amplification module comprising:

a Bi oxide based optical waveguide, comprised of Bi oxide based host glass, including an optical waveguide region doped with Er element, for propagating the signal light;

a pumping light supply system for supplying the optical waveguide region with pumping light so as to generate a population inversion within the optical waveguide region of said Bi oxide based optical waveguide; and

a control unit for adjusting an optical power of the pumping light supplied from said pumping light supply system to said Bi oxide based optical waveguide so as to yield a relative gain non-uniformity of less than 25% in a net gain spectrum of said Bi oxide based optical waveguide at a predetermined operating temperature within an operating temperature range of said optical amplification module.

4. An optical amplification module according to claim 3, wherein the relative gain non-uniformity is less than 19%.

5. An optical amplification module for collectively amplifying signal light having multiplexed a plurality of channels in a single wavelength band including a wavelength region having a wavelength of 1610 nm or longer, said optical amplification module comprising:

a Bi oxide based optical waveguide, comprised of Bi oxide based host glass, including an optical waveguide region doped with Er element, for propagating the signal light;

a pumping light supply system for supplying the optical waveguide region with pumping light so as to generate a population inversion within the optical waveguide region of said Bi oxide based optical waveguide; and

a control unit for adjusting an optical power of the pumping light supplied from said pumping light supply system to said Bi oxide based optical waveguide so as to yield a relative gain non-uniformity of less than 25% in a net gain spectrum of said Bi oxide based optical waveguide within a whole operating temperature range of said optical amplification module.

6. An optical amplification module according to claim 5, wherein the relative gain non-uniformity is less than 19%.

7. An optical amplification module for collectively amplifying signal light having multiplexed a plurality of channels in a single wavelength band including a wavelength region having a wavelength of 1610 nm or longer, said optical amplification module comprising:

a Bi oxide based optical waveguide, comprised of Bi oxide based host glass, including an optical waveguide region doped with Er element, for propagating the signal light;

a pumping light supply system for supplying the optical waveguide region with pumping light so as to generate a population inversion within the optical waveguide region of said Bi oxide based optical waveguide; and

a control unit for adjusting an optical power of the pumping light supplied from said pumping light supply system to said Bi oxide based optical waveguide so as to yield a relative gain non-uniformity of less than 25% in a net gain spectrum of said Bi oxide based optical waveguide in a wavelength bandwidth exceeding 37 nm within a whole operating temperature range of said optical amplification module.

8. An optical amplification module according to claim 7, wherein the wavelength bandwidth exceeds 50 nm.

9. An optical amplification module for collectively amplifying signal light having multiplexed a plurality of channels in a single wavelength band including a wavelength region having a wavelength of 1610 nm or longer, said optical amplification module comprising:

a Bi oxide based optical waveguide, comprised of Bi oxide based host glass, including an optical waveguide region doped with Er element, for propagating the signal light;

a pumping light supply system for supplying the optical waveguide region with pumping light so as to generate a population inversion within the optical waveguide region of said Bi oxide based optical waveguide; and

a control unit for adjusting an optical power of the pumping light supplied from said pumping light supply system to said Bi oxide based optical waveguide so as to yield a relative gain non-uniformity of less than 19% in a net gain spectrum of said Bi oxide based optical waveguide in a

wavelength bandwidth exceeding 37 nm within a whole operating temperature range of said optical amplification module.

10. An optical amplification module according to claim 9, wherein the wavelength bandwidth exceeds 50 nm.

11. An optical amplification module for collectively amplifying signal light having multiplexed a plurality of channels in a single wavelength band including a wavelength region having a wavelength of 1610 nm or longer, said optical amplification module comprising:

a Bi oxide based optical waveguide, comprised of Bi oxide based host glass, including an optical waveguide region doped with Er element, for propagating the signal light;

a pumping light supply system for supplying the optical waveguide region with pumping light so as to generate a population inversion within the optical waveguide region of said Bi oxide based optical waveguide; and

a temperature detecting device for detecting a temperature of said Bi oxide based optical waveguide or nearby.

12. An optical amplification module for collectively amplifying signal light having multiplexed a plurality of channels in a single wavelength band including a wavelength region having a wavelength of 1610 nm or longer, said optical amplification module comprising:

a Bi oxide based optical waveguide, comprised of Bi oxide based host glass, including an optical waveguide region doped with Er element, for propagating the signal light;

a pumping light supply system for supplying the optical waveguide region with pumping light so as to generate a population inversion within the optical waveguide region of said Bi oxide based optical waveguide; and

a temperature adjusting device for adjusting a temperature of said Bi oxide based optical waveguide or nearby.

28. An optical amplification module according to claim 3, satisfying the following relationship:

$\alpha_B \leq 0.021\alpha$

where α_B (dB/m) is the background loss of said Bi ~~type~~ oxide based optical waveguide, and α (dB/m) is the absorption peak due to Er.

29. An optical amplification module according to claim 3, satisfying the following relationship:

$\alpha_B \leq 0.015\alpha$

where α_B (dB/m) is the background loss of said Bi oxide based optical waveguide, and α (dB/m) is the absorption peak due to Er.

30. An optical amplification module according to claim 3, wherein said Bi oxide based optical waveguide includes an optical fiber.

31. An optical amplification module according to claim 3, wherein said pumping light supply system includes a light source having a center output wavelength falling within the range from 1453 nm to 1473 nm at the highest output.

32. An optical amplification module according to. claim 3, wherein said pumping light supply system includes a light source always having a center output wavelength falling within the range from 1453 nm to 1473 nm.

33. An optical amplification module according to claim 3, wherein said pumping light supply system comprises:

a semiconductor light-emitting device including a light-reflecting surface and a light-emitting surface opposing the light-reflecting surface; and

a grating for reflecting a part of light having a specific wavelength in light emitted from the light-emitting surface of said semiconductor light-emitting device, and making thus emitted light incident on the inside of said semiconductor light-emitting device from the light-emitting surface.

34. An optical amplification module according to claim 33, wherein said grating includes an optical fiber grating formed on an optical fiber.

39. An optical amplification apparatus comprising an optical amplification module according to claim 1, said optical amplification module amplifying signal light having multiplexed a plurality of channels included in L band.

41. An optical amplification apparatus according to claim 39, further comprising a Raman amplification optical fiber disposed on a transmission path of the signal light as to be located on the upstream side of said Bi oxide based optical waveguide as seen in a traveling direction of the signal light, wherein said Raman amplification optical fiber is supplied with at least one of pumping light near a wavelength of 1470 nm and pumping light having a wavelength of 1520 nm or more.

45. An optical amplification module according to claim 5, wherein the optical waveguide region doped with Er element is further doped with B element.

46. An optical amplification module according to claim 5, satisfying the following relationship:

$\alpha_B \leq 0.021\alpha$

where α_B (dB/m) is the background loss of said Bi oxide based optical waveguide, and α (dB/m) is the absorption peak due to Er.

47. An optical amplification module according to claim 5, satisfying the following relationship:

$\alpha_B \leq 0.015\alpha$

where α_B (dB/m) is the background loss of said Bi oxide based optical waveguide, and α (dB/m) is the absorption peak due to Er.

48. An optical amplification module according to claim 5, wherein said Bi oxide based optical waveguide includes an optical fiber.

49. An optical amplification module according to claim 5, wherein said pumping light supply system includes a light source having a center output wavelength falling within the range from 1453 nm to 1473 nm at the highest output.

50. An optical amplification module according to claim 5, wherein said pumping light supply system includes a light source having a center output wavelength falling within the range from 1453 nm to 1473 nm.

51. An optical amplification module according to claim 5, wherein said pumping light supply system comprises:

a semiconductor light-emitting device including a light-reflecting surface and a light-emitting surface opposing the light-reflecting surface; and

a grating for reflecting a part of light having a specific wavelength in light emitted from the light-emitting surface of said semiconductor light-emitting device, and making thus emitted light incident on the inside of said semiconductor light-emitting device form the light-emitting surface.

52. An optical amplification module according to claim 7, wherein the optical waveguide region doped with Er element is further doped with B element.

53. An optical amplification module according to claim 7, satisfying the following relationship:

$\alpha_B \leq 0.021\alpha$

where α_B (dB/m) is the background loss of said Bi oxide based optical waveguide, and α (dB/m) is the absorption peak due to Er.

54. An optical amplification module according to claim 7, satisfying the following relationship:

$\alpha_B \leq 0.015\alpha$

where α_B (dB/m) is the background loss of said Bi oxide based optical waveguide, and α (dB/m) is the absorption peak due to Er.

55. An optical amplification module according to claim 7, wherein said Bi oxide based optical waveguide includes an optical fiber.

56. An optical amplification module according to claim 7, wherein said pumping light supply system includes a light source having a center output wavelength falling within the range from 1453 nm to 1473 nm at the highest output.

57. An optical amplification module according to claim 7, wherein said pumping light supply system includes a light source having a center output wavelength falling within the range from 1453 nm to 1473 nm.

58. An optical amplification module according to claim 7, wherein said pumping light supply system comprises:

a semiconductor light-emitting device including a light-reflecting surface and a light-emitting surface opposing the light-reflecting surface; and

a grating for reflecting a part of light having a specific wavelength in light emitted from the light-emitting surface of said semiconductor light-emitting device, and making thus emitted light incident on the inside of said semiconductor light-emitting device form the light-emitting surface.

59. An optical amplification module according to claim 9, wherein the optical waveguide region doped with Er element is further doped with B element.

60. An optical amplification module according to claim 9, satisfying the following relationship:

$\alpha_B \leq 0.021\alpha$

where α_B (dB/m) is the background loss of said Bi oxide based optical waveguide, and α (dB/m) is the absorption peak due to Er.

61. An optical amplification module according to claim 9, satisfying the following relationship:

$\alpha_B \leq 0.015\alpha$

where α_B (dB/m) is the background loss of said Bi oxide based optical waveguide, and α (dB/m) is the absorption peak due to Er.

62. An optical amplification module according to claim 9, wherein said Bi oxide based optical waveguide includes an optical fiber.

63. An optical amplification module according to claim 9, wherein said pumping light supply system includes a light source having a center output wavelength falling within the range from 1453 nm to 1473 nm at the highest output.

64. An optical amplification module according to claim 9, wherein said pumping light supply system includes a light source having a center output wavelength falling within the range from 1453 nm to 1473 nm.

65. An optical amplification module according to claim 9, wherein said pumping light supply system comprises:

a semiconductor light-emitting device including a light-reflecting surface and a light-emitting surface opposing the light-reflecting surface; and

a grating for reflecting a part of light having a specific wavelength in light emitted from the light-emitting surface of said semiconductor light-emitting device, and making thus emitted light incident on the inside of said semiconductor light-emitting device form the light-emitting surface.

66. An optical amplification module according to claim 11, wherein the optical waveguide region doped with Er element is further doped with B element.

67. An optical amplification module according to claim 11, satisfying the following relationship:

$\alpha_B \leq 0.021\alpha$

where α_B (dB/m) is the background loss of said Bi oxide based optical waveguide, and α (dB/m) is the absorption peak due to Er.

68. An optical amplification module according to claim 11, satisfying the following relationship:

$\alpha_B \leq 0.015\alpha$

where α_B (dB/m) is the background loss of said Bi oxide based optical waveguide, and α (dB/m) is the absorption peak due to Er.

69. An optical amplification module according to claim 11, wherein said Bi oxide based optical waveguide includes an optical fiber.

70. An optical amplification module according to claim 11, wherein said pumping light supply system includes a light source having a center output wavelength falling within the range from 1453 nm to 1473 nm at the highest output.

71. An optical amplification module according to claim 11, wherein said pumping light supply system includes a light source having a center output wavelength falling within the range from 1453 nm to 1473 nm.

72. An optical amplification module according to claim 11, wherein said pumping light supply system comprises:

a semiconductor light-emitting device including a light-reflecting surface and a light-emitting surface opposing the light-reflecting surface; and

a grating for reflecting a part of light having a specific wavelength in light emitted from the light-emitting surface of said semiconductor light-emitting device, and making thus emitted light incident on the inside of said semiconductor light-emitting device form the light-emitting surface.

73. An optical amplification module according to claim 12, wherein the optical waveguide region doped with Er element is further doped with B element.

74. An optical amplification module according to claim 12, satisfying the following relationship:

$\alpha_B \leq 0.021\alpha$

where α_B (dB/m) is the background loss of said Bi oxide based optical waveguide, and α (dB/m) is the absorption peak due to Er.

75. An optical amplification module according to claim 12, satisfying the following relationship:

$\alpha_B \leq 0.015\alpha$

where α_B (dB/m) is the background loss of said Bi oxide based optical waveguide, and α (dB/m) is the absorption peak due to Er.

76. An optical amplification module according to claim 12, wherein said Bi oxide based optical waveguide includes an optical fiber.

77. An optical amplification module according to claim 12, wherein said pumping light supply system includes a light source having a center output wavelength falling within the range from 1453 nm to 1473 nm at the highest output.

78. An optical amplification module according to claim 12, wherein said pumping light supply system includes a light source having a center output wavelength falling within the range from 1453 nm to 1473 nm.

79. An optical amplification module according to claim 12, wherein said pumping light supply system comprises:

a semiconductor light-emitting device including a light-reflecting surface and a light-emitting surface opposing the light-reflecting surface; and

a grating for reflecting a part of light having a specific wavelength in light emitted from the light-emitting surface of said semiconductor light-emitting device, and making thus emitted light incident on the inside of said semiconductor light-emitting device form the light-emitting surface.

EVIDENCE APPENDIX

Not Applicable.

RELATED PROCEEDINGS APPENDIX

Not Applicable.